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ABSTRACT

The analysis of public goods is presented with a discussion of the rules for fertilizer and pesticide storage units in Indiana. A basic rule summary is presented with descriptions of the types of dikes that might be considered for containment. Estimated costs are projected along with the number of contained liquid fertilizer spills by size in Indiana from 1985-1990. The booklet concludes with a student quiz. (EH)

ECONOMIC ISSUES

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Agricultural Chemical and Fertilizer Storage Rules

Costs and Benefits of Insuring Cleaner Water for Indiana

Agricultural Chemical and Fertilizer Storage Rules

Costs and Benefits of Insuring Cleaner Water for Indiana

Based on the Senior Honors Thesis by Curt Krueger

About the Cover: Photo depicts a plentiful and clean water supply for working, recreation, and drinking.

ECONOMIC ISSUES... is published by the Office of Academic Programs, Mary A. Welch, Editor.

Introduction

The old adage, "there is no such thing as a free lunch," faces all of us as we consider the importance of a clean environment. Do we have a problem? Must we change? What is the price tag of change?

Agriculture provides Americans with food, fiber, and shelter. Fertilizers provide important nutrients to promote plant growth; pesticides help control weeds and insects. Concern is mounting that continuation of current fertilizer and pesticide practices, without additional measures to avoid accidental spills, may pollute our water supply.

Stewardship of the land is an important issue. According to an article in *Agrichemical Age*, "Agrichemical companies have no choice but to respond to growing concern over chemicals in the environment, and most companies now feel they are stewards for their products, from production to disposal. But just how much control do they have? Company representatives are not certified inspectors, and yet they can be liable for the effects their products have on health and safety. Regulations remain a patchwork quilt covering the 50 states, and the Environmental Protection Agency (EPA) knows this. The 1990s will bring more regulation, because currently the lines where government rules end and corporate attempts at product stewardship begin, remain blurred."

Safe water is a public good. Everyone benefits from it regardless of their contribution.

Public Goods

In microeconomic studies, the concept of private goods is used to describe certain types of products. Food, houses, cars, computers, and stereos are examples of private goods.

Public goods differ from private goods. Two examples of public goods are national defense and reduction in water or air pollution. The opposite of a public good is a "public bad." Environmental pollution is an example of a "public bad."

The government often provides public goods when the market fails to do so. The government can also limit "public bads" when the market does not. The reason existing markets do not work for public goods such as clean air or water is that the market mechanism operates on the principle that those who do not pay for private goods cannot consume or use them. This does not usually hold true for public goods. For example, everyone is protected by a national defense system whether they pay for it or not.

To determine if something is a public good, ask yourself, "Can I be excluded for any reason from benefitting?" If the answer is, "No," it is likely a public good.

If people cannot be excluded from the benefits of a public good, there is generally less incentive to contribute to supply such goods. Thus, these goods are undersupplied. To correct this, the government may provide such goods using general revenues to pay for them.

Adopted from Edwin Mansfield's *Microeconomics, Theory and Applications*, 2nd Edition.

An agricultural producer uses chemicals to treat crops just as a physician treats a person for a sore throat or inoculates a child for measles. To grow healthy plants that yield the most bushels per acre, chemicals can be sprayed on or incorporated into the ground before, during, or after crops are planted. Producers invest a large amount of money in crop protection. They use chemicals to help maximize production and profits. Pesticides and fertilizers are considered very safe if mixed and applied according to the company's specifications on the label. These specifications for pesticides are approved by the United States Environmental Protection Agency (EPA). However, improper handling or accidents in transporting or storing these products can create problems.

Dealers mix and store chemicals in readiness for sale to farmers during the planting season. Occasionally there are accidental spills and leaks during the process of mixing, transferring, and transporting chemicals, as well as leaks or ruptures of storage tanks. Indiana lawmakers are concerned that this may pose a risk to ground (well) and surface (rivers/lakes) water quality. A study by Richard Fawcett, a consultant and former Iowa State University agronomist, appeared in the 1990 mid-*March Farm Journal*. He investigated the pollution sources of 18 Iowa public well systems contaminated by pesticides. Sixteen had chemical.mixing and loading sites nearby, usually within a few hundred feet of the town or wellhead.

In response to these concerns and Indiana legislative action, the Indiana Office of the State Chemist was charged with establishing rules and regulations for fertilizer and pesticide storage.

What Are the Rules?- The rules for fertilizer and pesticide storage units (farm and/or dealer) in Indiana were published in the April 1991 *Indiana Register*. They went into effect in May (for pesticides) and July (for fertilizers) 1991. Anyone who stores liquid farm chemicals must build a dike or large basin around chemical storage tanks. In case of a leak or accidental spill, the chemicals will be contained in the basin (dike). Without this protection, spilled chemicals could leach into ground water or run off into surface water.

To determine if something is a public good, ask yourself, "Can I be excluded for any reason from benefitting?" If the answer is, "No," it is likely a public good.

According to the rules:

"— dike shall contain 100% of the volume of the largest storage container within the diked area plus the volume occupied by all other tanks, equipment, and appurtenances (valves, hoses, connections, etc.) in the area. In addition to this volume, the dike shall also be designed to include a freeboard space of six inches."

Freeboard space refers to additional measured inches of the dike wall above and beyond the calculated storage dimensions (i.e., Length x Width x Height) to contain 100% of the volume of the largest tank.

The six-inch freeboard space translates into 125 percent of storage capacity when the dike wall is about two feet high. If the dike wall approaches five feet in height, the capacity of the contained area decreases to about 110 percent. The extra volume will contain a leak even if it should occur during a heavy rainfall.

Rule Summary

The following summary is presented for general information. Readers can obtain complete rules from the Indiana Office of the State Chemist for detailed specifications.

A. Primary pesticide and fertilizer containers (including pipes, gauges, and other accessories) should be made of materials that are compatible with the product.

Additional Information: Materials used for constructing tanks and accessories should be resistant to corrosion, puncture, or cracking.

B. Underground storage of both fertilizer and pesticides is prohibited.

Additional Information: It is difficult or impossible to detect leaks in underground tanks.

C. Dikes, or secondary containment facilities, are a major part of the proposed

rules for both pesticides and fertilizers.

Additional Information: The diked area shall be constructed with a base, perimeter wall, and sloped floor and drain, with exceptions noted in the complete rules.

Any diked area shall be used for the storage of one kind of chemical (i.e., either fertilizers or pesticides). The dike should be maintained at all times. If the dike is not protected from rainfall, the basin shall be large enough to contain more liquid should excessive rainfall occur at the time of an accidental leak or spill. By reviewing rainfall records in Indiana for the past 10 years, recommended holding capacities were made to determine what capacity is needed for the maximum spilled liquid plus the largest rainfall during a 24-hour period in Indiana.

The walls of a diked area shall be constructed of earth, steel, concrete, or solid masonry and have design features to withstand the force of discharged liquid.

Earthen wall dikes shall be lined with concrete, steel, an approved synthetic liner, or clay soil liner designed to seal against leaching of chemicals through base or walls. Earthen dikes are not permitted for pesticide storage.

D. Concrete unloading pads with curbed sides and a 750- gallon capacity including the catch basin for both fertilizer and pesticides will be required. The unloading pad must be 10 foot by 20 foot minimum dimensions with the strength to support the weight of a loaded delivery vehicle.

Additional Information: Vehicles carrying chemicals must load and unload over the constructed area in case of accidental spills or leaks; the protected area will catch, drain, and contain any spilled chemical materials.

The total catch area must handle at least 750 gallons of discharged fluid. This volume was determined as the amount that might be spilled before a unit could be shut off.

E. Other rules define regulations on record keeping, inspections, and security for the storage units.

Additional Information: Fenced areas protect against wildlife, vandalism, and unauthorized access, all of which may result in damage to and subsequent discharge from the storage tanks. Records allow for checking and reporting of unaccounted for materials over specified periods of time.

Who will the Rules Affect? The rules will affect anyone who stores liquid bulk fertilizer in containers that hold more than 2,500 gallons each or dry bulk fertilizer in containers that hold more than 12 tons each. If a dealer or farmer has six containers of fertilizer holding 500 gallons each, that individual would be exempt from compliance even though the total storage capacity is more than 2,500 gallons.

Krueger (left) discusses operation and benefits of diked fertilizer with Steve Wilson of Wilson Fertilizer, Inc. in Brook, Indiana.

Jeff Boese, president of the Indiana Plant Food and Agricultural Chemicals Association, says the major concern of dealers is the economic feasibility of complying. "Lending institutions do not like to loan money when the loan won't generate a profit." As a best guess, Boese suggests that the cost to an average dealership in Indiana would be $30,000 to $50,000—a sizable investment. However, estimated costs for larger facilities with multiple locations could be in excess of one million dollars.

Because the costs for dealer or farmer compliance are high, it is prudent to consider the benefits of such a large investment for the individual business as well as for society. However, it is difficult to put a price on the following benefits: 1) protection of environmental quality, 2) worker safety, 3) compliance with federal and state regulations, 4) enhancement of owner/operator management, and 5) reduced legal liability.

In the mid-March, 1990 *Farm Journal*, David Kammel, Agricultural Engineer at the University of Wisconsin, commented, " A chemical containment facility is expensive, but not compared with what it could cost to clean up after a ruptured mini-bulk tank." By complying, an owner also reduces the possible cost of legal liability. A chemical spill could cause a violation of state and federal environmental regulations for which penalties could cost up to $25,000 per day.

Curt Krueger, a graduate of Purdue University's Agricultural Economics Department, compiled information on the rules and types of dikes. He developed a model to estimate the cost to a dealer of implementing these regulations.

There are three types of dikes that might be considered.

I. Poured Concrete

This method is permanent. It cannot be moved if the dealer closes or moves to another location. However, the construction is less expensive than a portable dike (sometimes referred to as a modular unit). A dealer moving a large volume of product will more quickly pay for the investment of a poured dike, as he pays more quickly for any capital investment.

Krueger (right) surveys (160,000) gallon-tanks diked at Wilson Fertilizer, Inc. in Brook, Indiana.

II. Portable Dike

The advantage of this system is the ease of relocation, should the need arise. The initial expense is higher compared to a poured dike. The increased cost might be justified by its greater flexibility.

III. Earthen Dike

The costs of an earthen dike rely heavily on where it is built. Krueger, therefore, did not estimate the costs of an earthen dike.

During his investigations, Krueger developed a relatively simple mathematical model to calculate costs for a small, medium, and large-sized firm to construct concrete dikes.

Table 1 summarizes Krueger's calculations for estimating total costs (dike, load-out pad, tanks, and miscellaneous equipment) for a small, medium, and large firm.

According to David Kammel from the University of Wisconsin in Madison, total construction costs (materials and labor) can be estimated by multiplying the cost of concrete per cubic yard times 2.5. Krueger estimated total construction costs in Table 1 by assuming $60 per cubic yard for concrete ($60 x 2.5 = $150). Thus Krueger estimated the total costs in Table 1 by using $150 per cubic yard of concrete.

Table 1 also compares the total estimated costs for building concrete dikes with estimates to purchase and install a modular or portable dike system to contain similar volumes of fluid. Total costs include dike, loading pad, tanks, and other items necessary to construct a site.

Table 1. Estimated costs of poured concrete compared to portable dikes for small, medium, and large firms.

Type of Dike	Total Costs of a small firm (total storage is 26,000 gallons) whose largest tank holds 20,000 gallons	Total Costs of a medium firm (total storage is 68,000 gallons) whose largest tank holds 50,000 gallons	Total Costs of a large firm (total storage is 208,000 gallons) whose largest tank holds 50,000 gallons
Poured Concrete	$25,465	$48,556	$116,216
Portable or Modular	$36,440	$62,886	$115,420

Protecting the environment is the primary objective of these new rules. Estimating costs to the environment was not the main focus of Krueger's thesis. He investigated the costs associated with past cleanups and the known history of spills in Indiana. However, those only provide a measure of the cleanup costs avoided, not the environmental costs associated with fish kills, soil sterilization, water contamination, and health hazards to humans and animals. While unquantified in this study, most citizens of Indiana would agree that these environmental costs are significant.

Donald Horning, Coordinator of Environmental and Regulatory Services for Indiana Farm Bureau, maintains an average cost of ng up a spill is approximately $1.00 per gallon. This is for cleanup procedures alone; it does not include the cost of the product. Additional cleanup costs for a spill of 1,000 gallons of product will average between $4,000 and $6,000. These costs include equipment, soil removal, inspection, and soil replacement. If the spill is an emergency and an Emergency Spill Response Team must be called to assist, the cost could be as much as $1,000 plus $750-$1,000 per hour for a full-response team of three to four persons. Supplies for an emergency spill could increase the cost even further.

Thus a spill of a few hundred to 1,000 gallons would cost $1,000 - $7,000; larger spills of several thousand gallons could cost $10,000—$20,000 or more for adequate cleanup. If ground water or surface water contamination should occur, costs would increase dramatically.

Indiana's Department of Environmental Management (DEM) collected data on spills for five years. Table 2 summarizes these data. As you can see, spills have occurred and cleanup costs have been paid.

A survey by the Association of American Plant Food Control Officials indicated that there were 645 fertilizer operations in Indiana in 1988. Ninety-five percent of these plants (613) are estimated to handle liquid fertilizer. Assuming the fertilizer is contained on site and given the spill data of Table 2, liquid fertilizer spills averaged 23 per year. If no plant is more likely than another to experience a spill, the chance of any single plant experiencing a spill in one year is therefore estimated at 3.8% (23.3 divided by 613). Such a spill could be one of the small spills, less than 250 gallons. Twenty eight percent of the 124 contained liquid fertilizer spills of known size in the DEM data were small; but 4 percent were over 15,000 gallons, with possible costs of up to $75,000.

Table 2. Number of contained liquid fertilizer spills by size in Indiana (January, 1985 to July, 1990).

Size	Number of spills of this size	Estimated range of firm clean-up costs for this size spill
<250 gallons	35	up to $5,220 [a]
Between 250 and 1000 gallons	31	$6,250—$8,500 [b]
Between 1000 and 15,000 gallons	53	$7,000—$43,500 [c]
>15,000 gallons	5	$37,500—$75,000 [d]
Unknown amount	6	Unknown

a\—Largest spill in this category (220 gal.) x $1.00 + $5,000.
b\—250 x $1.00 + $6,000 to 1000 x $2.50 + $6,000.
c\—1,000 x $1.00 + $6,000 to 15,000 x $2.50 + $6,000.
d\—Smallest spill in this category (15,000 gal.) x $2.50 to the largest spill in this category (30,000 gal.) x $2.50 based on reported cleanup costs of one 40,000 gal. spill.

Given the costs and benefits, a company might well decide not to construct a containment dike if it were not required by law. However, in response to growing public concern and the increased value society is placing on environmental quality (public good), industries must consider other elements in addition to the cost of constructing a dike. These factors include possible legal liabilities and public image. As a result of the factors associated with these new rules, dealers and farmers will need to comply in order to continue to conduct business. While the major benefit is to society in terms of environmental protection, the farmer or dealer is also avoiding the costs associated with cleaning up spills.

Summary

There is growing concern that accidental leaks and spills of fertilizers and other agricultural chemicals could endanger surface and ground water supplies. This contamination could trigger human health problems as well as endanger aquatic and riparian (close to the water's edge) or terrestrial (land) animals, destroy recreational fishing, and generally degrade the quality of our natural environment. Rules to protect the environment from accidental contamination have been compiled by the Indiana Office of the State Chemist. These regulations became effective in 1991. The cost to dealers will range from $25,465 to $116,216 for a concrete dike, depending on the size of the firm. However, a dealer or farmer who does not have a dike could incur cleanup costs associated with spills ranging up to $75,000 (without the assistance of an emergency response cleanup team). At an additional cost of $1,000 plus $750 -$1,000 per hour for professional assistance, the price increases appreciably depending on the volume of the spill.

While the costs of complying with these regulations are high, the environmental costs associated with fish kills, soil sterilization, and water contamination are significant. In addition, these costs do not reflect insurance rates or liability costs should a firm face a legal suit.

The citizens of Indiana, through their elected members of the General Assembly, have indicated that the environmental risks associated with agricultural chemical storage and handling should be reduced. Regulations have been established and are outlined in this publication. The estimated costs are presented which businesses (handling agricultural chemicals) must bear to help protect Indiana water supplies.

Stephen B. Lovejoy

As Associate Professor of Agricultural Economics, Steve Lovejoy coordinates the Center for Alternative Agricultural Systems at Purdue University. The purpose of the Center is to foster and promote interdisciplinary research, extension, and teaching alternative agriculture, including low input and sustainable management practices.

The goals for the Center include helping Indiana citizens meet their objectives of abundant, relatively inexpensive food supplies, a clean environment, safe food, and a prosperous agricultural sector. Lovejoy has interest in research and topics that will bring these goals to fruition. Dr. Lovejoy worked with Curt Krueger to develop his research honors thesis. Professor Lovejoy's advice and technical assistance in developing this issue is acknowledged and greatly appreciated.

Stephen B. Lovejoy

Deborah J. Brown

As Associate Professor and Director of the Department of Agricultural Economics Undergraduate Honors Thesis Program, Dr. Brown worked closely with Curt Krueger in preparing his extensive study on diking for storing agricultural fertilizers. Brown teaches classes focusing on price analysis and econometrics. Professor Brown's suggestions and technical input for this issue are greatly appreciated.

Deborah J. Brown

QUIZ:

Multiple Choice — Circle the letter of the most appropriate answer for each of the following.

1. Environmental regulations are on the rise due to
A. rising concern of the general public.
B. ground water contamination has been discovered near a few chemical dealerships.
C. the lawmakers of Indiana asking the State Office of the Indiana Chemist to prepare a set of rules.
D. All of the above are true.
E. A and B only are true.

2. The new rules specify that the basin to contain a potential chemical spill or leak shall hold 100% of the volume of the largest storage container inside the dike plus the volume occupied by all other tanks, equipment, and appurtenances plus an extra free-board space of six inches
A. only if the dike is not protected by a roof.
B. so that heavy rainfall will not cause the dike to overflow.
C. which translates to 125% of the total volume if the dike wall is about two feet high.
D. All of the above are true.
E. None of the above is true.

3. Which of the following is NOT one of the rules?
A. As long as the volume meets the standards, any type of chemical can be stored inside the diked area.
B. Non-corrosive materials must be used to construct the holding tanks for chemicals.
C. Chemical storage underground is almost exclusively prohibited.
D. The tanks must be routinely inspected and reports kept.

4. Which of the following is NOT considered a "potential benefit" according to the data Curt Krueger collected for this report?
A. Avoiding costs for cleanup equipment and possible fines
B. Killing fish if the spill washed into a nearby creek
C. Getting a tax deferrment on concrete costs if a dike is constructed
D. All of the above are true.
E. None of the above is true.

5. According to a recent article in *Agrichemical Age*,

A. the current government rules remain a patchwork because regulations are not consistent or non-existent.

B. chemical company representatives are not certified inspectors.

C. chemical companies can be liable for their products if they endanger the health or safety of workers or the public.

D. All of the above are true.

E. None of the above is true.

6. One of the new regulations requires a load-out pad be constructed with drains and automatic sump pump. Why do you think this was determined as necessary?

A. To keep accidental spills contained (avoiding contact with the ground).

B. Many spills are likely to happen during mixing, loading, or unloading chemicals.

C. To keep the area clean so that dirt will not get into the mixture.

D. All of the above are true.

E. None of the above is true.

F. Only A and B are true.

7. In order for a dealer to avoid complying with the new regulations, smaller tanks (less than 2,500-gallon capacity) can be installed even though their combined storage capacity is 100,000 gallons.

True

False

8. As the new rules are stated and amended, a dealer with ten tanks of fertilizer holding 2,000 gallons each of chemicals would be exempt from complying.

True

False

9. According to a *Farm Journal* report, federal and state violation penalties can range up to $25,000 per day.

True

False

10. Which of the following is NOT an example of a public good?

A. Lighthouse

B. Telephone service from New York to Los Angeles

C. City mosquito control program
D. National defense

11. Estimate the cost of constructing a rectangular dike of the following dimensions using the information you learned from the text.
Length of contained area = 50 ft.
Width of contained area = 40 ft.
Height of walls = 2 ft.
Thickness of walls and floor = 1 ft.
A. $13,111
B. $1,311
C. $1,600
D. $16,666
E. $5,000

12. To which of the following benefits of building a diked system is it difficult or impossible to attach a price?
A. worker safety
B. 5000 gallons of spilled fertilizer on the ground (some of it will seep into the soil)
C. reduced legal liability
D. protection of environmental quality
E. Benefits from all of the above are difficult to measure.
F. A and D only are true.

Answers:
1-D; 2-D; 3-A; 4-C; 5-D; 6-F; 7-True; 8-True; 9-True; 10-B; 11-A; 12-E

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OVER

Introduction

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